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IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF ALASKA AT ANCHORAGE

ENOCH ADAMS, JR., LEROY ADAMS, ANDREW KOENIG, JERRY NORTON DAVID SWAN and JOSEPH SWAN, Plaintiffs, v. TECK COMINCO ALASKA INCORPORATED Defendant.	Case No. A04-49 (JWS) EXPERT DECLARATION OF ROBERT MORAN
NANA REGIONAL CORPORATION and NORTHWEST ARCTIC BOROUGH, Intervenors-Defendants.	

I, Robert Moran, declare:

1. I am over 18 and not a party to this action.

Qualifications

2. I am a specialist in water quality, hydrogeology and geochemistry, and President of Moran and Associates. I hold a Bachelor of Arts degree in Zoology from San Francisco State College and a Ph.D in Geological Sciences from University of Texas.

3. I have more than thirty-two years of domestic and international experience in conducting and managing water quality, geochemical and hydrogeologic work for private investors, industrial clients, Tribal and citizens groups, non-governmental organizations (NGOs), law firms, and governmental agencies at all levels. Much of my technical expertise involves the quality and geochemistry of natural and contaminated waters and sediments as related to mining, nuclear fuel cycle sites, industrial development, geothermal resources, hazardous wastes, and water supply development. In addition, I have significant experience in the application of remote sensing to natural resource issues, development of resource policy, and litigation support.

4. I have taught courses to technical and general audiences, and have given expert testimony on numerous occasions. I have worked on projects in numerous countries, including: Australia, Greece, Mali, Senegal, Guinea, Gambia, South Africa, Oman, Pakistan, Kazakhstan, Kyrgyzstan, Argentina, Chile, Honduras, Mexico, Peru, Canada, Great Britain, and United States.

5. Among recent international work, I reviewed the environmental impact assessment on water and other environmental issues, and the permit conditions, at the proposed Esquel mine in northern Patagonia, Argentina. In Southern Mali I reviewed the environmental conditions and documents related to an IFC-funded gold mine. I reviewed water and environmental issues at the

San Andres mine in Honduras. In Peru I reviewed mining water and environmental issues, which included numerous public presentations to citizens and governmental groups, including members of the Peruvian Congress. In Greece I gave technical assistance to an advisory arm of the Greek government and citizens groups regarding gold mining and environmental issues. In Australia I reviewed water quality issues related to cyanide leach gold operations on aboriginal lands and gave testimony at the Land and Environment Court. I evaluated environmental costs associated with copper mining in Chile. In South Africa I taught cyanide technology and environmental assessment issues at a United Nations-sponsored course. In Kyrgyzstan I gave water quality instruction to regulators and NGOs regarding mining, sampling, laboratory procedures, and general environmental issues, and reviewed a local laboratory.

6. I have prepared geochemical and hydrogeology studies and monitored water quality at mining sites across the United States. For instance, I have given litigation support on water quality, geochemistry, and treatment issues to groups opposed to a proposed gold operation at the Crown Jewel Mine in Washington. I assumed technical and management responsibilities for water resources and geochemistry tasks in preparation of an Environmental Impact Statement (EIS) at a gold-cyanide leach site with existing acid drainage problems for Zortman Mining Co. and the U.S. Bureau of Land Management. I was responsible for geochemistry and water quality aspects of a supplemental EIS at a new gold mine site for Echo Bay Mining. I have overseen water quality sampling, and evaluated water quality and remote sensing activities related to major water development litigation in the San Luis Valley, Colorado. I acted as a geochemical/water quality consultant at the Beartrack mine site, a proposed cyanide-leach gold project in Idaho. I evaluated existing surface and groundwater quality data and suggested remedial activities to deal

with excessive manganese and dissolved organic concentrations and provided testimony to the Brighton City Council in Colorado.

7. I have worked for groups as diverse as the U.S. Environmental Protection Agency, Kennecott Utah Copper, Oxfam America, Greenpeace Argentina, Asociation de Organismos No Gubernamentales, Nacho Nyak Dun First Nation, Dogrib Nation, Soros Foundation Kyrgyzstan, Mineral Policy Center, World Resources Institute, U.S. Bureau of Land Management, U.S. Forest Service, Molycorp/Unocal, Southern Peru Copper Corp., Zortman Mining Co., Chino Mines, Amax Gold/Haile Mining, Anschutz Mining Corporation, Kemmerer Coal Company, Anaconda Copper Company, Southern Pacific Petroleum, Cambior Minerals, City of Brighton, Colorado Water Resources and Power Authority, University of Wisconsin, Dames and Moore, Advanced Sciences, Inc., and Earth Satellite Corporation.

8. While with the U.S. Geological Survey Water Resources Division for six years, I was responsible for the design, management, and implementation of nine hydrogeological/geochemical studies. These studies covered the extent and magnitude of mining and mine drainage on the quality of Colorado streams; investigation of selenium and associated constituents at the margins of Rocky Flats Nuclear Facility; evaluation of existing and potential water quality problems from underground coal mines; evaluation of the hydrochemistry of thermal resources throughout Colorado; and investigation of the movement of chromium and other metals from tailings ponds into alluvium at Telluride, Colorado.

9. I have authored and co-authored over 32 technical papers on the environmental impacts of mining, mining regulation and the effects of mining activities on water quality. In particular, I have written reports on the geochemistry of selenium in groundwater, the effects of metal-mine

drainage on water quality, arsenic at gold mining sites, and cyanide in mining-related waters. My Ph.D dissertation, published in 1974, dealt with hydrogeologic and geochemical issues at a mining district in Colorado. Several other technical papers have dealt with environmental hydrochemistry issues.

10. I have given technical presentations or been co-author on presentations given at: the Geological Society of America's Annual Meeting; the Meeting on Exploitation of Gold Deposits in Thrace, Greece; the Central Asian Ecology-99 Conference in Kyrgyzstan; the Third International Conference on Tailings & Mine Waste (co-author); the American Institute of Hydrology Meeting on Water Resources at Risk; the International Symposium on Acid Mine Water in Pyritic Environments (co-author); the Society of Mining Engineers Meeting (co-author); the International Symposium on Water-Rock Interaction in Czechoslovakia; and the American Water Resources Association's Meeting on Water Resources Problems Related to Mining.

11. A true and correct copy of my resume is attached.

12. I have examined the NPDES permits for Teck Cominco's Red Dog mine and the Red Dog port site. I have also examined the Discharge Monitoring Reports (DMRs) for the mine and port sites from 1998 to 2002. I have also reviewed many of the letters from Teck Cominco to EPA admitting exceedances of Teck Cominco's NPDES permits. I have also reviewed Teck Cominco's Revised Opposition to KRPC's Motion for Partial Summary Judgment, and the declarations Teck Cominco submitted supporting that Opposition in the related case Kivalina Relocation Planning Committee v. Teck Cominco Alaska, Inc., No. A02-231 CV(JWS).

13. I toured the Red Dog mine facilities in 1996 while employed by Woodward Clyde Consultants.

14. I have participated in projects involving the use of cyanide in the mining industry for more than 30 years. Many of my publications have dealt with cyanide as it is used by the mining industry, including:

Moran, Robert E., 1998, Cyanide Uncertainties—Observations on the Chemistry, Toxicity, and Analysis of Cyanide in Mining-Related Waters: Mineral Policy Center Issue Paper No.1, Wash., D.C.

Moran, Robert E., 2000, Cyanide in Mining: Some Observations on the Chemistry, Toxicity and Analysis of Mining-Related Waters: in Proc. Central Asia Ecology '99, Lake Issyk Kul, Kyrgyzstan, June,1999.

Moran, R.E., 2000, Cianuro: Algunos Conceptos Basicos: Informativo Mensual; Sociedad Nacional de Mineria, Petroleo y Energia, Vol. 9, no. 10, pg. 58-59.

Moran, R.E., 2001, More Cyanide Uncertainties: Lessons from the Baia Mare, Romania, Spill---Water Quality and Politics. Mineral Policy Center Issue Paper No. 3, Wash. D.C.

Moran, Robert E., 2002, De-coding Cyanide. A Submission to the European Union and the United Nations Environment Programme: Sponsored by Hellenic Mining Watch, Ecotopia, CEE Bankwatch, FOE Europe, FOE Hungary, FOE Czech Republic, Food First Information and Action Network, Minewatch UK, and Mineral Policy Center.

Testimony relating to Red Dog Mine and Port

Cyanide

15. Cyanide is a well-known poison, extremely toxic to humans and most forms of aquatic and terrestrial life. In addition, cyanide used at mining sites readily reacts to form other cyanide-related compounds which, while generally less toxic than cyanide itself, are nevertheless toxic to aquatic organisms. It is reasonable for the public to be concerned about the presence of cyanide in the water they drink. There are even more significant reasons for citizens to be concerned about the presence of cyanide and cyanide-related compounds in rivers from which

they catch and consume fish. These concerns are reasonable even where measured cyanide concentrations (WAD or Total) are as low as a few tens of micrograms per liter.

16. The standard cyanide analytical techniques (free, WAD and Total) fail to detect many of the potentially toxic cyanide-related compounds that are often present in mining effluents. These compounds often include cyanate, thiocyanate and several metal-cyanide complexes. While it may be correct that the presence of these compounds makes accurate and precise analyses more difficult, the more relevant point is that these compounds can be toxic to aquatic organisms at very low concentrations. In addition, truly long-term studies on the toxicity of these compounds to aquatic life and humans are largely lacking.

17. All routinely-used analytical methods for the determination of cyanide in water and sediments have shortcomings, and present inherent problems with respect to providing accurate and reproducible (precise) data. This is true of all the Free Cyanide, WAD Cyanide, and Total Cyanide analytical methods. Regulators, scientists and industry have been well aware of most of these difficulties for decades. Nevertheless, the discharge permit for site 001 was written requiring that the presence of cyanide be monitored using the Total Cyanide analytical method, and stipulated that the daily maximum and monthly average limits for total cyanide were 9μg/L (micrograms per liter) and 4μg/L, respectively.

18. Commercial laboratories are capable of quantifying cyanide samples near or below the daily maximum 9μg/L and monthly average 4μg/L limits. Teck Cominco's reports of cyanide levels that exceed daily maximum and monthly average limits of 9 μg/L and 4 μg/L respectively are reflective of actual violations of Teck Cominco's permit levels.

19. At Red Dog and other similar mineral processing sites, it is appropriate to monitor for Total Cyanide because it indirectly indicates the presence of several forms of toxic cyanide-related compounds which are not detected by WAD cyanide determinations, such as several of the metal-cyanide complexes. This is especially important for the common iron-cyanide complexes, which release toxic free cyanide when exposed to various intensities of artificial light and sunlight. Iron-cyanides are one of the main components in forest fire retardant compounds, which have been shown to be extremely toxic to fish. Recently, the EPA confirmed that iron-cyanide compounds are legally considered as cyanides. See Federal Register, pages 57690-57691 (October 6, 2003), a true and correct copy of which is attached as Exhibit 6. Although EPA considers iron-cyanide complexes or compounds to be cyanide, they are not detected by WAD CN determinations.

20. Even where both Total and WAD Cyanide determinations are made, numerous forms of potentially toxic cyanide-related compounds are not detected, such as: thiocyanates, cyanates, selected metal-cyanide complexes (i.e. most cobalt and platinum cyanides), and most organic-cyanide compounds. It is disingenuous for Teck Cominco to claim that thiocyanate acts as an interference for the Total Cyanide method, but fail to mention that thiocyanate itself is also toxic to aquatic organisms — and is not detected in either the WAD or Total CN analyses.

21. Teck Cominco's repeated failure to meet the cyanide permit limitations lead me to be of the opinion that there is a reasonable likelihood that Teck Cominco will violate its cyanide permit limitations again in the future, if it has not done so already.

WET Testing

22. The Red Dog mine uses massive quantities of numerous reagents in its processing of the mine ore. According to information sent by Teck Cominco to KRPC, these reagents include: 53 tonnes/year (tpy) Methyl Isobutyl Carbinol, 587 tpy Potassium Ethyl Xanthate, 891 tpy potassium amyl xanthate, 319 tpy sodium matabisulfite, 455 tpy zinc sulfate, 5375 tpy copper sulfate, 155 tpy sodium cyanide, 324 tpy sodium sulfide, 8818 tpy line, 41 tpy antiscalent, and 94 tpy flocculent. These figures are based on the letter from James Kulas, environmental manager at Red Dog, to Enoch Adams, Jr., Chair of KRPC, on October 13, 2002, which I have reviewed.

23. I have also reviewed the letter from James Kulas, environmental manager at Red Dog, to Enoch Adams, Jr., Chair of KRPC, on October 11, 2002 and its attachment.

24. Routine monitoring of Teck Cominco's effluent and the waters impacted by Teck Cominco's discharges do not directly survey for most of these reagents. Many of these reagents or their breakdown products would likely be in the total load discharged by Teck Cominco.

25. Because the 2002 water sampling near Kivalina was performed in December, when the Red Dog mine was not discharging, these samples are not likely to be representative of the water quality in the Wulik River during months when mine discharge does occur. 26. The fact that water meets drinking water standards for certain parameters does not necessarily mean it is safe for human or animal consumption or non-toxic to aquatic life. Mining effluents, even treated effluents that comply with all NPDES limits for specific chemicals, may still be toxic to aquatic organisms. This conclusion has often been verified by various forms of toxicity testing in both the United States and Canada. While the exact explanation is usually unclear, it is likely that the effluents contain concentrations of some chemical constituents not included in the list of

monitored constituents. WET tests provide the best synoptic means of evaluating the overall toxicity of such chemically-complex effluents.

27. The fact that water samples comply with NPDES or other regulatory limits for total dissolved solids (TDS) content does not mean the TDS found in the water is benign or non-toxic.

28. The mine is required by its NPDES permit to perform whole effluent toxicity tests, also known as WET tests. Under the permit, the WET tests involve the use of a species of water flea, *Ceriodaphnia dubia*, and a small fish, *Pimephales promelas*. These WET tests are used precisely because of the complexities mentioned above. That is, these organisms are exposed to various concentrations of the effluent to determine the degree to which it may be toxic. WET tests often indicate potential toxicity even though the concentrations of all chemical constituents tested in the water sample are in compliance with the NPDES limits.

29. The repeated failure of the mine's WET tests (Teck Cominco has reported violations to EPA of its WET permit limits in September 1998, May 1999, July 1999, August 2000 and August 2001, as well as in September 2002) indicates that the effluent is, indeed, toxic to some forms of aquatic life in the receiving water.

30. The repeated failures of the WET test at the mine make Kivalina residents' concerns about the impact of the mine's effluent on fish and other water-borne life reasonable.

31. Teck Cominco's repeated failure to meet the WET effluent limitations lead me to be of the opinion that there is a reasonable likelihood that Teck Cominco will violate its WET permit requirements again in the future, if it has not done so already.

Cadium

32. Teck Cominco has admitted that it has violated their mine permit on several occasions with respect to cadmium. Teck Cominco has stated that the past violations were due to various combinations of human, analytical and computer programming errors that control the addition of sodium sulfide, thereby limiting the cadmium concentrations in the effluent. My experience with mine operations indicates it is reasonable to assume that comparable human, analytical and programming errors are likely to occur in the future, leading to similar cadmium violations. Teck Cominco has also claimed a variety of other problems at the mine that led to violations of other permit parameters, including equipment failure, computer program failure, weather delays and staffing rotation. The combination of these factors with Teck Cominco's admitted problems complying with its cadmium permit limits in October 2000 and July 2001, when it reported 40 violations, lead me to be of the opinion that there is a reasonable likelihood that Teck Cominco will violate its cadmium permit limitations again in the future, if it has not done so already.

33. Teck Cominco's permit requires that it not exceed either daily maximum discharge limits or maximum monthly average discharge limits for cadium. Both measurements are important and serve overlapping but distinct purposes. Teck Cominco has admitted that it exceeded the daily maximum effluent limit for cadium on July 30, 2001. This single upset was so large as to cause both a violation of the daily maximum limit and a violation of the monthly average limit.

Port Site Self Monitoring and Reporting Violations

34. Teck Cominco admits that it has violated its port permit on several occasions with respect to its monitoring requirements. Teck Cominco has stated that the past violations were due

to various combinations of weather delays, human error, laboratory error, equipment failure, and computer program failure, which prevented Teck Cominco from obtaining the required data. My experience with mine operations indicates it is reasonable to assume that comparable human and equipment errors are likely to occur in the future, leading to similar violations. Likewise, if a weather-related delay caused a permit violation in the past, a weather-related delay could reasonably be expected to cause a similar permit violation in the future.

TDS

35. Numerous mines are operated worldwide within the arctic, and most of them collect specific conductance (S.C.) measurements of water samples using some form of automated equipment. All experience some degree of equipment failures and data transmission problems due to human error and the harsh arctic weather. Nevertheless, most of these sites are capable of using the S.C. measurements to make estimates of TDS, based on the relationships of historical S.C., temperature and lab-determined TDS data.

36. The Red Dog site has water quality data from the early 1980s, much of which includes S.C. and lab-determined TDS, thus an historic relationship was obviously available when the mine permit was written. Partly on the basis of the historic data, the permit includes a daily maximum TDS limitation of 196 mg/L, and allows TDS concentrations to be calculated using site historical S.C. data. However, the mine treatment plant effluent (site 001) frequently violated this TDS permit limit and even the much higher TDS levels in Consent Orders issued by the U.S. EPA. Teck Cominco states that these exceedances were not truly permit violations because its staff had been using incorrect conversion factors for calculating TDS, which were revised on the basis of data from 1999 and 2000. However, Teck Cominco has had relevant historical water

quality data from the early 1980s through the 1990s that should have allowed determination of an appropriate conversion factor to calculate TDS. Only after a lawsuit was filed documenting numerous TDS permit violations did Teck Cominco then seek to revise the conversion factors. It is reasonable to conclude that the originally-reported TDS violations represent actual violations, despite being calculated using pre-1999-2000 conversion factors.

37. Teck Cominco has previously stated that these TDS violations are the result of various types and combinations of equipment failure, communications failures, human error, and weather problems, and further states that such problems will not recur in the future. If such equipment and communications failures or breakdowns could reasonably be expected to cause permit violations in the past, given my 30+ years of experience in mining, I believe similar conditions could reasonably be expected to cause similar permit violations in the future, particularly given the adverse weather conditions in which the mine operates. Likewise, if a weather-related delay caused a permit violation in the past, a weather-related delay could reasonably be expected to cause a similar permit violation in the future. Solar flares that Teck Cominco claims have caused violations in the past will happen in the future and can reasonably be expected to cause similar violations

38. Teck Cominco states that a substantial part of the alleged permit violations described in paragraph 37 resulted from the use of Envista (Environmental Information Management System) software package and has previously suggested that there is a reasonable likelihood that no future violations resulting from the use of the Envista will occur. This seems an especially naïve statement as such data software packages are almost always subject to some degree of error.

Given my years of experience in the mining industry, I would reasonably expect some form of computer or software error to occur at the mine in the future.

39. The treated effluent at site 001 and numerous other non-point sources around the mine add significant volumes of TDS and other chemical constituents in both dissolved and particulate forms into the Middle Fork Red Dog Creek. While much of the chemical load released into the drainage system is originally in dissolved form, it rapidly converts into particles which settle to the stream bottom. These particles are partly composed of metal compounds, and metal-cyanide compounds, many of which may be ingested by benthic organisms and fish, leading to toxic responses in the aquatic communities.

40. TDS, cyanide, cadmium and other chemical constituents discharged by Teck Cominco into the Middle Fork Red Dog Creek will flow downstream with the regular stream flow, entering the Main Stem Red Dog Creek, the Ikalukrok Creek, and the Wulik River, in turn. Once in the Wulik they will flow downstream to the mouth of the Wulik with the regular flow of the river.

41. If Kivalina residents take drinking water from the Wulik River, some contaminants discharged by the mine are likely to be in that water. It is reasonable for the residents to fear the presence of these contaminants in their drinking water.

42. Harms to human health, the aquatic wildlife, and the environment caused the by discharge from the mine will be less likely and/or less severe if Teck Cominco abides by its permit requirements.

43. Teck Cominco has stopped reporting TDS at the discharge pipe (Outfall 001) every day, and now conducts conductivity measurements downstream with TDS measurements at the pipe reported only once a week. Conductivity measurements taken downstream at Station 151 and

Station 10 are directly correlatable with the TDS measurements at the pipe. Thus TDS measurements at the Outfall 001 that violate the permit can be readily correlated to conductivity measurements downstream, and vice versa. One can therefore reasonably estimate with confidence the TDS concentrations at Outfall 001 based on the conductivity measurements at Station 151 and Station 10. Based on the calculated TDS concentrations at Station 10, and the reported TDS concentrations at Station 151 found in Teck Cominco's June 2004 Discharge Monitoring Report, it is apparent that the TDS concentrations of the discharge at Outfall 001 on June 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, and 15, 2004 were above 196 mg/l. According to the June 2004 Discharge Monitoring Report, the mine did not discharge on June 11 or 12, 2004.

Signed under penalty of perjury this 23rd day of September at Golden, Colorado.

Robert Moran

Robert Moran

Expert Rebuttal Report of Robert Moran:

Introduction.

This report offers rebuttal opinions to the expert reports of Gene Andrews, Michael Botz, Kevin Brix, and Joyce Tsuji.

Materials Reviewed

In developing these rebuttal opinions I reviewed the following documents:

- the Expert Reports of Gene Andrews, Michael Botz, Kevin Brix, and Joyce Tsuji;
- the Red Dog DMRs for NPDES site 001;
- the references cited at the end of these rebuttal opinions;
- all materials listed in my previous expert declaration.

Opinions and Observations.

Re. Gene Andrews Expert Report.

Mr. Andrews (Expert Report, 2004, Attachment 1, pg. 15-16) states that mine water treatment has converted the Red Dog waters from largely toxic to non-toxic and uses the Pre-and Post-Mining TDS compositions as evidence (Table 2, page, 15). Unfortunately, TDS in no way provides any specific chemical information. Also, Table 2 contains ranges of data only for: hardness, TDS, sulfate, cadmium, copper, lead, and zinc.

However, the Red Dog mine processing facilities receive geochemically-complex mixtures of rock and water [low pH, metals/metalloids (elevated concentrations of many potentially toxic constituents such as: aluminum, antimony, arsenic, barium, cadmium, copper, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc, together with elevated concentrations of the major metals: calcium, magnesium, sodium and potassium), and nonmetals [sulfate, nitrate, ammonia, boron, phosphorus, fluoride, chloride], and natural radioactive constituents (uranium, thorium, potassium-40, gross alpha and beta, in general).

Two recent papers document the presence of most of these constituents in the Red Dog rocks (Slack et.al., 2004a and b). Other chemical constituents listed above, but not mentioned in the Slack papers are listed because they are almost always present in metal mine effluents.

In order to separate and extract the desired metals from the ore, the following chemical reagents are added: methyl isobutyl carbinol, potassium ethyl xanthate, sodium ethyl ether, potassium amyl xanthate, sodium isobutyl xanthate, sodium metabisulfite, zinc sulfate, copper sulfate, sodium cyanide, sodium sulfide, lime, sodium hydroxide, organic antiscalents and flocculents (correspondence: James Kulas, Teck Cominco to Enoch Adams, Jr., Oct. 11 and 13, 2002). Tons per year

of most of these reagents are used in processing at Red Dog. For example, about 155 tons per year of sodium cyanide is used, which generates numerous cyanide and related breakdown compounds (metal-cyanide complexes, cyanate, thiocyanate) as wastes. In addition, the mine utilizes tremendous quantities of explosives [i.e. ANFO, ammonium nitrate-fuel oil, dynamite, etc.; for example, an average of 1,506,499 lbs of ANFO per day (Kulas letter to E. Adams, Oct.11, 2002)] and fuels (diesel, gasoline, kerosene), oils and lubricants, the residues of which are routed into the mine wastes and then to the treatment plant.

This chemically diverse "soup" of natural and industrial chemicals is far too toxic to be released directly into the environment, thus it is sent to the treatment plant. However, Andrews makes no mention of and cites no data for most of these chemical constituents in the monitoring of the treatment plant effluent samples and other samples.

Andrews, in his expert report, fails to present any ion balances, complete or incomplete, to demonstrate that the TDS data he uses are reasonable and reliable. Nevertheless, he alleges that, since mining and water treatment have commenced, that the discharge and TDS have become benign, or non-toxic to aquatic organisms. He fails to present data adequate to substantiate these statements.

Total Dissolved Solids (TDS) is a *general* measure of the chemical components dissolved in a water sample. There are several methods by which TDS can be determined, but most simply, they involve: 1) analytically determining a "complete" suite of the major and minor chemical constituents in the water and mathematically summing the results, or 2) evaporating the water sample to dryness and weighing the residue. *Regardless of which method is employed, the laboratory reports the TDS concentration in milligrams per liter (mg / L), and this result, by itself, tells the observer nothing about the specific chemical composition or toxicity of the water sampled.*

In order to gain a detailed understanding of the chemical components actually present in a water sample--and indirectly represented by the TDS concentration—the sample must be analyzed for a wide range of major and minor chemical components. The major ions should include, as a minimum, silica, calcium, magnesium, sodium, potassium, alkalinity, sulfate, chloride, and nitrate (Skougstad, et.al, 1979). However, when water samples are either acidic or highly alkaline, numerous minor constituents become dissolved at significant concentrations and become important components in the determination of TDS. Many of these normally minor chemical constituents may be toxic to aquatic organisms and other life. Such is the situation at the Red Dog Mine. Most of the water samples are acidic prior to treatment and are rendered highly alkaline during treatment.

According to data in Scannell (1996), treated effluents released to Red Dog Creek from NPDES site 001 during 1995 often had pH values as high as 10. Similar elevated pH levels, sometimes above 10, are reported on the site 001 DMRs for 1999—2003 and into 2004. Clearly such effluents would be toxic to many aquatic organisms strictly on the basis of elevated pH. In addition, evidence from numerous other mine sites shows that such high pH treated effluents often contain elevated concentrations of many potentially toxic minor constituents, either in solution or as microparticles.

The opinions presented by Mr. Andrews in his Expert Report, Nov.15, 2004, concerning the feasibility of various water treatment options should be, of necessity, based on detailed, high quality data on flow and water quality. However, Mr. Andrews fails to present a **detailed** summary of the overall water quality data, both influent and effluent, on which he bases his opinions. In fact, in Attachment 1 of his Expert Report (Andrews, Aug. 1997), at the top of page 16, he states: "Though a complete data set is not available for each of the various sampling periods or sample points, several facts are illustrated in the table:" In fact, the table referred to by Mr. Andrews summarizes almost none of the available data and very little of the important data necessary to adequately evaluate the treatment options. As mine operations began in 1989, this lack of detailed data summary is an unreasonable excuse for the failure to perform a detailed analysis.

The geochemical data presented in Slack (2004 a, and b) indicate that the Red Dog rock contains significant concentrations of many potentially toxic metalloids, two of which are arsenic and antimony. Nevertheless, Andrews fails to present any water quality data in Table 2 of Attachment 1 to his Expert Report (Nov. 15, 2004) on the presence of either arsenic or antimony. Table 1 of the same report does show the treated *effluent* concentration for arsenic, but reports the concentration as < 2 mg/L. Such a detection limit is far too high to be useful or meaningful in terms of evaluating the potential toxicity to receiving waters. Because this table fails to report the *influent* arsenic concentration, it is also not useful for evaluating the efficiency of this treatment approach for arsenic removal. By comparison, all of the treatment systems listed for other mines in this table show much lower effluent arsenic concentrations than those reported for Red Dog.

When considering the impacts of Red Dog discharges to the environment and their potential impacts on local and regional water quality and aquatic life, it is imperative that all sources of releases to the aquatic environment are evaluated. This would include releases of water quality constituents in dissolved, colloidal and suspended forms. Aquatic organisms are capable of ingesting chemical constituents both from the water column and the bottom sediments. In addition, given various statements by Mr. Andrews regarding the unexpected volumes of water encountered at Red Dog, it is also reasonable to assume that data on both point source and non-point source releases should be considered in evaluating

the impacts of the Red Dog project on local water quality. Mr. Andrews has failed to address these issues.

As stated above, aquatic organisms are capable of ingesting chemical constituents in both dissolved and particulate forms. As such, it is necessary to monitor and evaluate data on contaminant **loads** released into the environment, in addition to concentrations, when evaluating potential changes in the water quality and toxicity of the Red Dog area drainages. Load is the mass of a chemical constituent, such as TDS, released from or mobile at that site. Loads are calculated by multiplying the chemical constituent concentration x the stream flow or discharge volume at that site.

The surface areas of mineralized rock exposed at the site have greatly increased as a result of mining activities. In addition, the volumes of water entering the mainstem of Red Dog Creek have increased drastically from pre-mining conditions to the present. Thus, it is critical to quantify the contaminant loads entering the local and regional surface waters in order to evaluate the total releases of potentially toxic materials into the environment. For example, the TDS loads at monitoring station 10 during pre-mining years, 1979-1983, were about 67,180 lbs / day. The TDS loads for the months during which discharges were reported in 2002 (June through October) ranged from 222,679 to 408,736 lbs. / day at station 10. By comparison, the TDS load released from the treatment plant outfall, station 001, ranged from 86,250 to 263,180 lbs. / day in 2002. The pre-mining data are taken from a summary of the 1979-82 data compiled in Scannell (Feb. 1996). The 2002 data come from the Discharge Monitoring Reports submitted by the company to EPA.

Scannell reports that median stream flow at station 10 had increased from 32 cfs during pre-mining to 182.6 cfs. in 1995.

On page 23, Mr. Andrews argues that the original water treatment plant design was based on an assumption that ground water would not need to be collected and treated. Based on the baseline water quality data presented by Dames and Moore (1983) and the exploration geochemical information which the company already possessed, that assumption appears untenable.

Re. Expert Report of Michael Botz

1-Relevance to Permit.
Mr. Botz has argued that Total Cyanide in the Red Dog waters cannot be reliably quantified at low concentrations. However, the NPDES permit for site 001 became effective in July,1998 and this permit required that cyanide be monitored using the Total CN method, with permit limits of 4 µg /L and 9 µg/L, and a Compliance Evaluation Level of 9 µg / L. Cyanide data were collected by Teck Cominco according to this permit between 1998 and 2003 without having the

permit changed with respect to cyanide. Teck Cominco did not challenge the permit limitations.

2-Data Quality.
Most of Mr. Botz's opinions are based on the position that the analytical techniques utilized by the two laboratories that Teck Cominco used to perform Total CN analyses between 1998 and 2002 were incapable of producing reliable, quantitative results at low concentrations. Thus, these arguments question the overall quality of the monitoring data. Mr. Botz rightly states at the top of page 7, that there is error with all analytical measurements. However, most water quality experts, myself included, would argue that the total error or uncertainty in water quality data results from a combination of numerous factors related to both *field sampling* and *laboratory analytical procedures*. In fact, at sites having chemically-complex waters, such as metal mine sites, it is generally true that the total error introduced by variability in sample collection and handling procedures is considerably greater than the error resulting from laboratory procedures. In other words, the procedures one uses to collect, handle and transport chemically-complex samples usually accounts for much more of the reporting error than do the analytical errors.

Unfortunately, Mr. Botz fails to present any discussion or analysis of the variability due to sampling error. In numerous statements, all of the Teck Cominco experts have mentioned the harsh conditions at Red Dog site, using these as explanations for many of the lapses in past monitoring or performance. Thus, it would be reasonable to expect that they, including Mr. Botz, would have taken great pains to quantify the sources of sampling and analytical errors, using statistically-reliable approaches, with "blind" samples [samples labeled so that analysts could not identify individual replicates], *independent* round-robin studies, etc. Apparently, none of these approaches were used by Mr. Botz to reliably quantify variability due to either sampling or analytical errors.

Mr. Botz provides no evidence that the routine analytical performance of the two laboratories used by Teck Cominco for cyanide analyses were subject to *independent* round-robin scrutiny, checking their accuracy and precision on chemically-complex waters. No information is provided to indicate that these two labs were chosen because of positive performance in such independent tests using chemically complex waters.

None of the Teck Cominco experts, including Mr. Botz, present details on the actual sample collection and handling procedures used at Red Dog. As a result, we are unable to assess the variability resulting from such issues as depth-integration of samples, compositing of samples and the timing of preservation, holding times, data reporting errors, etc. Again, none of these issues were evaluated or discussed, and they routinely tend to account for greater amounts of error in reported results than do the sum of the analytical errors.

On page 20, Botz discusses a study conducted by E&E 2004 --which I have yet to be provided with-- that evaluated the variability of cyanide data collected from NPDES outfall 001, using numerous, *unnamed* laboratories, two of which were the labs that performed cyanide determinations of Red Dog analyses during the period of 1998—2002. While several labs were part of this comparative study, only the data and conclusions from the two labs employed by Teck Cominco are presented and discussed. Once again, no specific details are presented on how split sampling and sample handling were performed. Presumably, all of the effluent monitoring data discussed by Botz, including discussions in his Expert Report sections 6.0—8.0, were collected by staff or representatives of Teck Cominco. There is no discussion of any 001 site sample results that have been *collected and analyzed* by *independent parties*. Thus, the public is forced to evaluate the details of these cyanide and other analytical issues using only company-collected samples.

In section 7 of his Expert Report, Botz calculates Method Detection Limits (MDL) and Minimum Levels (ML) using the *split sample* data from the E&E 2004 study, which are, apparently, from samples collected during 2003-2004. However, he does not include or discuss the cyanide data from *all of the labs* in the E&E study. Apparently the 41 replicate samples discussed in Table 8, on which the calculated MDLs and MLs are based are actually the 31 replicates discussed previously in table 7---but this is unclear.

Botz states that, under perfect conditions, the pairs of replicate samples would all have the same CN concentrations. However, again, we are not told any details about how the replicates were collected, split and handled, on what dates and times they were collected, were they "blind" replicates, etc. Furthermore, he uses these data to calculate MDLs and MLs as though they are replicates of the same sample---*which they are not*. Based on the limited explanation given, I can only conclude that the data in tables 7 and 8 represent 31 (41?) pairs of split samples, each pair collected at a different time, and possibly on different dates.

The chemical composition of the ore and the operational efficiency of both the mine ore processing facilities and the water treatment plant all vary continuously through time. *Hence, the chemical content of effluent samples collected from discharge site 001 would also vary continuously*. Thus, the replicate samples shown in tables 7 and 8 represent 31 different samples, split into pairs, of the effluent chemical quality---*not* 31 (or 41 as listed in Table 8) replicates of effluent water with the same composition. Botz has made statistical calculations on the assumption that there is a sample / population of 31 (or 41) replicates, when in fact there is only a statistical population of 2 for 31 (or 41) different samples / populations. Thus, Botz's MDL and ML calculations were performed using inappropriate approaches and data that do not come from 31 true replicate samples and therefore lead to unreliable conclusions.

It would be informative to see a statistically-correct evaluation of the E&E (2004) results using data from all of the laboratories investigated, evaluating all of the data for both WAD and Total CN analytical methods. There is no disagreement that all data are subject to error, including data from Total and WAD CN determinations. However, Botz has not demonstrated in a statistically-reliable fashion how much total error is present in the 1998 –2002 Red Dog Total CN data.

3-Analytical Interferences.

Mr. Botz argues that the presence of numerous chemical compounds can interfere with the analysis of cyanide in water samples. This is correct. In fact, some degree of analytical interference is the norm when analyzing chemically-complex waters. However, Mr. Botz presents no data reporting the presence or actual concentrations of these interfering compounds / constituents in actual Red Dog samples. In order to reliably demonstrate the interference effects of these compounds he would need to present the thiocyanate, sulfide, nitrate and nitrite concentrations, for example, in statistically-significant numbers of samples of Red Dog samples. No such data are provided.

Many of the chemical compounds listed as interferences by Mr. Botz on page 7, such as aldehydes, glucose and other sugars, and fatty acids, are not routinely reported as being present in mine waters. If their presence is an analytical concern, then their concentrations *in Red Dog samples* should have been demonstrated and quantified, along with their interference effects. No such data have been presented.

Many of the technical references on chemical interferences cited by Mr. Botz and Dr. Mudder were published many years prior to the issuance of the Red Dog NPDES permit, yet Teck Cominco did not challenge the Total CN requirements of the permit when it was issued in 1998.

On pages 9-11, Mr. Botz discusses thiocyanate as an interferant in Total Cyanide analyses using data from *prepared* solutions, not Red Dog samples. He provides no quantitative data on the routine presence of thiocyanate in Red Dog samples. Equally significant, these synthetic samples were prepared by adding 100 **mg/L** of thiocyanate to a solution containing only 250 **µg/L** of total CN. Thus, the synthetic samples had *very high* concentrations of thiocyanate as compared to the *much lower* concentrations of the other total cyanide contents. Yet, Mr. Botz fails to provide any data to demonstrate the reasonableness of these proportions or the concentrations of thiocyanate in Red Dog samples. Nor does he demonstrate the degree of interference from thiocyanate in actual Red Dog samples.

The interference data (synthetic samples) presented by Mr. Botz show that thiocyanate may theoretically interfere in both routine Total and WAD CN determinations.

On page 11, Mr. Botz presents data on synthetic samples showing the interference effects of nitrate and nitrite. Both compounds might *theoretically* be acting as interferences at Red Dog, but as no actual Red Dog nitrite or nitrate sample concentrations are presented, this is pure speculation. It is quite rare, however, to measure significant concentrations of nitrite in mine surface waters. On the other hand, nitrate is quite common in mine effluents (often in association with toxic ammonia), resulting from both the decomposition of other mine chemicals and as a residue from the use of blasting compounds. As a minimum, these studies should have reported statistically-valid concentrations of the common nitrogen forms (i.e. nitrate, nitrite, ammonia, organic nitrogen) present in actual Red Dog waters when evaluating potential analytical interferences.

4-Toxic CN Forms

On pages 4 through 6 and other pages, Mr. Botz discusses the various forms of cyanide in natural environments. This discussion is, however, quite incomplete and misleading in several aspects. For example, it is misleading to focus on free CN as the only environmentally important and toxic form of CN---especially when there are no approved or reliable analytical methods for determining free CN at low concentrations. The goal should be to measure all of the forms of cyanide and related compounds that are known to be toxic in aquatic systems, not simply to measure free CN.

The analytical procedure referred to as Total Cyanide does not, contrary to what is implied in its name, report all of the environmentally-important forms of CN (Moran, 1998, 2000, 2001, 2002). The same is true for the weak acid dissociable (WAD) CN analytical procedure. Neither method reports thiocyanate (British Columbia, 1986). Thiocyanate and cyanate are commonly present in mine waters where metal-sulfide ores exist, such as at Red Dog, and are toxic to aquatic organisms. It is correct that both cyanate and thiocyanate are less toxic than free CN to aquatic organisms, but both forms are toxic in and of themselves. Thus, it is especially misleading to refer to thiocyanate as simply a source of analytical interference.

Both WAD and Total CN analytical methods fail to report / detect the presence of many other forms of CN or CN-related compounds likely to be present in metal mine waters. Thus, contrary to the statements made by Mr. Botz, it is much more likely that both WAD and Total CN determinations routinely under-report, rather than over-report the presence and potential toxicity of CN and related forms in mine waters.

It is also misleading to simply report that many metal-cyanide complexes are of little importance in terms of toxicity to aquatic organisms. Firstly, data on the toxicity of many of these complexes to aquatic organisms are simply lacking. Secondly, many of these complexes are themselves reported to be toxic to aquatic organisms but also release free cyanide when exposed to sunlight. Mr. Botz's expert report does not discuss these complexes.

5-Analysis of Background Water Samples
Mr. Botz fails to present any quality assurance-quality control information (QA/QC) on the performance of these laboratories, including statistically-valid evaluations of spikes, precision and accuracy, or independent round-robin performance data. These data do not necessarily represent the actual presence of cyanide compounds in the site background waters, but could equally indicate laboratory contamination. We are not informed whether any of these three labs were the same labs used by Teck Cominco for routine CN monitoring during the1998- 2002 period of interest. It is unclear whether these data were utilized in the later E&E (2004) study.

6-Cyanide Speciation Analyses.

Section 6.3 of Botz's Expert Report states that low concentrations of metal-cyanide complexes were measured in the Outfall 001 samples analyzed by Frontier Geosciences. However, the report does not discuss the criteria used to select samples for CN speciation analysis. Botz does not explain whether the Outfall 001 samples chosen for speciation were representative of the full range of Total CN concentrations, or whether only low Total CN samples were selected. Also, the range of specific metal-cyanide complexes determined by Frontier Geosciences was quite limited and neglected to include many of the dozens of other potential metal-cyanide complexes that might be expected in such mine effluents (Flynn and Haslem,1995), including iron and manganese complexes.

Section 6.3 of Botz's report fails to discuss whether potential chemical interference agents were measured in the Red Dog CN speciation samples, the extent of the interference, and the overall precision and accuracy of the procedures, together with the overall speciation sample collection and handling procedures.

Re. Expert Report of Kevin Brix.

Note: Many of my comments made above concerning the opinions of Gene Andrews and Michael Botz are also relevant to the opinions of Kevin Brix. Among others, the comments relating to overall water quality and sediment sampling inadequacies and CN sampling and toxicity are relevant to Mr. Brix's opinions.

1-Teck Cominco committed violations of its NPDES permit for cadmium, total dissolved solids, cyanide, and whole effluent toxicity (WET) at the Red Dog Mine between August 1998 and May 2003.

2-Releases of contaminants from the Red Dog Mine caused increased loading of contaminants to the environment which likely contaminated both waters and bottom sediments. Contaminants in the bottom sediments can become redissolved under changing water chemical conditions, and be consumed by aquatic organisms, both as dissolved and particulate forms.

3-Teck Cominco performed inadequate studies to identify and address the environmental and human health risks to the region.

4-The fact that water samples comply with NPDES or other regulatory limits for total dissolved solids (TDS) content does not mean the TDS found in the water is benign or non-toxic.

5- Mr. Brix argues that TDS concentrations are largely benign in terms of potential toxicity to aquatic organisms and other life. However, Total Dissolved Solids (TDS) is simply a *general* measure of the chemical components dissolved in a water sample. *TDS concentrations, by themselves, tell the observer nothing about the specific chemical composition or toxicity of the water sampled.*

In order to gain a detailed understanding of the chemical components actually present in a water sample--and indirectly represented by the TDS concentration—the sample must be analyzed for a wide range of major and minor chemical components. The major ions should include, as a minimum, silica, calcium, magnesium, sodium, potassium, alkalinity, sulfate, chloride, and nitrate (Skougstad, et.al, 1979). However, when water samples are either acidic or highly alkaline, numerous minor constituents become dissolved at significant concentrations and become important components in the determination of TDS. Many of these normally minor chemical constituents may be toxic to aquatic organisms and other life. Such is the situation at the Red Dog Mine. Most of the water samples are acidic prior to treatment and are rendered highly alkaline during treatment.

According to data in Scannell (1996), treated effluents released to Red Dog Creek from NPDES site 001 during 1995 often had pH values as high as 10. Similar elevated pH levels, sometimes above 10, are reported on the site 001 DMRs for 1999—2003 and into 2004. Clearly such effluents would be toxic to many aquatic organisms strictly on the basis of elevated pH. In addition, evidence from numerous other mine sites shows that such high pH treated effluents often contain elevated concentrations of many potentially toxic minor, either in solution or as microparticles.

5- Red Dog mine processing facilities receive geochemically-complex mixtures of rock and water [low pH, metals/metalloids (elevated concentrations of many

potentially toxic constituents such as: aluminum, antimony, arsenic, barium, cadmium, copper, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc, together with elevated concentrations of the major metals: calcium, magnesium, sodium and potassium), and nonmetals [sulfate, nitrate, ammonia, boron, phosphorus, fluoride, chloride], and natural radioactive constituents (uranium, thorium, potassium-40, gross alpha and beta, in general). Two recent papers document the presence of most of these constituents in the Red Dog rocks (Slack et.al., 2004a and b). Other chemical constituents listed above, but not mentioned in the Slack papers are listed because they are almost always present in metal mine effluents.

In order to separate and extract the desired metals from the ore, the following chemical reagents are added: methyl isobutyl carbinol, potassium ethyl xanthate, sodium ethyl ether, potassium amyl xanthate, sodium isobutyl xanthate, sodium metabisulfite, zinc sulfate, copper sulfate, sodium cyanide, sodium sulfide, lime, sodium hydroxide, organic antiscalents and flocculents (correspondence: James Kulas, Teck Cominco to Enoch Adams, Jr., Oct. 11 and 13, 2002). Tons per year of most of these reagents are used in processing at Red Dog. For example, about 155 tons per year of sodium cyanide is used, which generates numerous cyanide and related breakdown compounds (metal-cyanide complexes, cyanate, thiocyanate) as wastes. In addition, the mine utilizes large quantities of explosives (i.e. ANFO, ammonium nitrate-fuel oil, dynamite, etc.) and fuels (diesel, gasoline, kerosene), oils and lubricants, the residues of which are routed into the mine wastes and then to the treatment plant.

This chemically diverse "soup" of natural and industrial chemicals is far too toxic to be released directly into the environment, thus it is sent to the treatment plant. However, Mr. Brix makes no mention of and cites no data for most of these chemical constituents in the Red Dog water samples. Likewise, he fails to consider most of these constituents in either water or sediment samples when evaluating potential toxicity to any forms of life.

Routine monitoring of Teck Cominco's effluent and the waters impacted by Teck Cominco's discharges do not directly survey for most of these reagents. Many of these reagents or their breakdown products would likely be in the total load discharged by Teck Cominco.

6-The treated effluent at site 001 and numerous other non-point sources around the mine add significant volumes of TDS and other chemical constituents in both dissolved and particulate forms into the Middle Fork Red Dog Creek. While much of the chemical load released into the drainage system is originally in dissolved form, it rapidly converts into particles which settle to the stream bottom. These particles are partly composed of metal compounds, and metal-cyanide compounds, many of which may be ingested by benthic organisms and fish, leading to toxic responses in the aquatic communities.

7- The fact that water meets drinking water standards for certain parameters does not necessarily mean it is safe for human or animal consumption or non-toxic to aquatic life. Mining effluents, even treated effluents that comply with all NPDES limits for specific chemicals, may still be toxic to aquatic organisms. This conclusion has often been verified by various forms of toxicity testing in both the United States and Canada. While the exact explanation is usually unclear, it is likely that the effluents contain concentrations of some chemical constituents not included in the list of monitored constituents. WET tests provide the best synoptic means of evaluating the overall toxicity of such chemically-complex effluents.

8-Teck Cominco has failed to collect monitoring data for numerous chemical constituents in both its effluent and ambient monitoring that are known to be toxic to aquatic life and human health if present in excessive concentrations in both sediments and water. These include, for example, antimony, arsenic, thallium, uranium and others. It seems likely that the presence of many of these undetermined chemical constituents discharged into the Red Dog surface waters could be the cause for much of the unexplained toxicity mentioned in Mr. Brix's opinions.

9-The mine is required by its NPDES permit to perform whole effluent toxicity tests, also known as WET tests. Under the permit, the WET tests involve the use of a species of water flea, *Ceriodaphnia dubia*, and a small fish, *Pimephales promelas*. These WET tests are used precisely because of the complexities mentioned above. That is, these organisms are exposed to various concentrations of the effluent to determine the degree to which it may be toxic. WET tests often indicate potential toxicity even though the concentrations of all chemical constituents tested in the water sample are in compliance with the NPDES limits.

10- The repeated failure of the mine's WET tests (Teck Cominco has reported violations to EPA of its WET permit limits in September 1998, May 1999, July 1999, August 2000 and August 2001, as well as in September 2002) indicates that the effluent is, indeed, toxic to some forms of aquatic life in the receiving water.

Re. Expert Report of Joyce Tsuji.

Note: Many of my comments made above concerning the opinions of Gene Andrews, Michael Botz and Kevin Brix are also relevant to the opinions of Joyce Tsuji. Among others, the comments relating to overall water quality and sediment sampling inadequacies and CN sampling and toxicity are relevant to Dr. Tsuji's opinions.

1-Water for the drinking water system of Kivalina was drawn from the Wulik River at Station 1 into a holding tank in August 2002. One presumes that this water was then chlorinated, but that is undetermined. This water is stored as a source for use later in the year. During the summer, however, residents of Kivalina take

drinking water directly from the Wulik River. As Teck Cominco did not collect samples from this storage tank until December 2002, these samples are not representative of the water quality in the tank soon after water extraction in August, nor are they representative of drinking water taken directly from the river during the summer.

2-TDS, cyanide, cadmium and other chemical constituents discharged by Teck Cominco into the Middle Fork Red Dog Creek will flow downstream with the regular stream flow, entering the Main Stem Red Dog Creek, the Ikalukrok Creek, and the Wulik River, in turn. Once in the Wulik they will flow downstream to the mouth of the Wulik with the regular flow of the river.

3-Harms to human health, the aquatic life, and the environment caused the by discharge from the mine will be less likely and/or less severe if Teck Cominco abides by its permit requirements.

I reserve the right to modify and supplement my opinions as further information becomes available, including through deposition of defendant's experts, and to express new opinions in response to new information or to opinions expressed by defendant's experts. Additionally, I have not been given access to several of the reports and publications on which Andrews, Botz, Brix and Tsuji relied in making their expert opinions; I have been informed by plaintiffs' counsel that these documents were requested of Teck Cominco (T-C) but have not been provided to plaintiffs. I reserve the right to modify and supplement my opinions once I have been provided all data and publications on which defendant's experts relied.

The fact that I have focused only on certain statements in the reports of Andrews, Botz, Brix and Tsuji does not reflect my acceptance or agreement with those statements not specifically addressed here.

In reviewing the Expert Report of Gene Andrews, a number of lines of text were printed on top of each other, making it difficult and sometimes impossible to read the lines. This includes, but is not limited to, lines on page 2 (paragraph 2), page 3 (paragaphs 3 and 4), page 4 (paragraph 13, 15, 16), page 9 (paragraphs V and VI), and page 12. I reserve the right to modify and supplement my opinions once these lines of text are provided to me in a legible form.

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Executed this 10th day of January, 2005 at Golden, Colorado.

Robert E. Moran

Rebuttal of Robert Moran to
Kevin Brix"s Supplemental Report

In the United States District Court for the District of Alaska at Anchorage

Adams et al v Teck Cominco Alaska Incorporated
Case No. A04-49 CV (JWS)

Signed this 9th day of February, 2005

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2-9-2005

Rebuttal Comments to Supplemental Expert Report of Kevin Brix

Opinions.

1- The findings in Mr. Brix's Supplemental Expert Report have little or no relevance to the potential aquatic toxicity issues under dispute because these tests failed to use test waters having comparable water quality to those of actual Red Dog mine (RDM) effluents.

2- It is well documented that effluents from mine sites impacted by acid mine drainage have ionic compositions considerably more complex than those presented in various water quality tables (for example tables 1, 3, 4, 5, 6) in the Brix Supplemental Expert Report. The test waters synthetically created for these studies did not contain numerous chemical constituents that would be found in representative samples of Red Dog Mine effluents as ionic species. In addition, these synthetic test waters did not contain numerous other trace chemical constituents that are likely present in RDM effluents and in the local receiving waters.

3- On pg. 9, Mr. Brix states that: " Because salmonids will not be exposed to whole effluent……" Firstly, the exact meaning of this statement is unclear. Clearly the salmonids do not have any choice as to whether they will be exposed to the whole effluent, under test conditions. Secondly, this statement is further evidence that the chemical compositions of the test waters created and utilized by Brix in these studies are not comparable to the compositions of the actual RDM effluents or the waters at the relevant Red Dog monitoring stations.

4- The Brix Supplemental Expert Report is not an independent expert's study and the technical approach is self-serving. All activities presented in this report were funded by Teck Cominco and it appears that all chemical analyses were performed in Teck Cominco labs.